

Appl. No. 10/780,527
Amdt. Dated June 22, 2006
Reply to Office Action of March 24, 2006

Attorney Docket No. 81863.0026
Customer No.: 26021

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Canceled).
2. (Currently amended) The surface-coated member according to claim [[1]] 6, wherein the mean crystal width of the ~~stringer-like~~ TiCN crystal on the Al_2O_3 layer side is from 0.2 to 1.5 μm .
3. (Currently amended) The surface-coated member according to claim [[1]] 6, wherein the mean crystal width of the ~~stringer-like~~ TiCN crystal on the base body side is 0.7 times or less as the mean crystal width w_2 on the Al_2O_3 layer side.
4. (Currently amended) The surface-coated member according to claim [[1]] 6, wherein at least one layer comprising a material selected from a group consisting of TiN, TiCN, TiC, TiCNO, TiCO and TiNO is interposed between the layers of said ~~stringer-like~~ TiCN layer comprising at least two layers.
5. (Currently amended) The surface-coated member according to claim [[1]] 6, wherein said Al_2O_3 layer has an α type crystal structure.

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6. (Currently amended) ~~The A surface-coated member according to claim 1 comprising the following (1a) through (1c):~~

(1a) the surface-coated member comprising a base body, and a hard coating layer comprising at least a TiCN layer and an Al₂O₃ layer formed in this order on the surface of the base body;

(1b) said TiCN layer comprising TiCN crystal that is grown in a direction perpendicular to said base body; and

(1c) said TiCN crystal comprising at least two layers wherein the mean crystal width thereof is larger on the Al₂O₃ layer side than on said base body side, wherein said TiCN layer comprises a carbon-rich TiCN layer located on top of said Al₂O₃ layer side where the ratio C/N of proportions of carbon C and nitrogen N is in a range of $1.5 \leq C/N \leq 4$, and a nitrogen-rich TiCN layer located below the carbon-rich TiCN layer where the ratio C/N is in a range of $0.2 \leq C/N \leq 0.7$.

7. (Original) The surface-coated member according to claim 6, wherein a ratio t_C/t_N of the thickness t_C of the carbon-rich TiCN layer to the thickness t_N of the nitrogen-rich TiCN layer is in a range from 0.8 to 1.2.

8. (Currently amended) The surface-coated member according to claim [[1]] 6, wherein such a binding layer that comprises mainly of at least titanium (Ti), aluminum (Al), tungsten (W) and cobalt (Co) is formed between said TiCN layer and said Al₂O₃ layer.

9. (Original) The surface-coated member according to claim 8, wherein said binding layer is formed through diffusion of elements from one or more of said base body, said TiCN layer and said Al₂O₃ layer.

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10. (Original) The surface-coated member according to claim 8, wherein said binding layer has intermittent structure and, when it is assumed that the binding layer had continuous and uniform structure, mean thickness of said binding layer is from 0.05 to 4 μm .

11. (Original) The surface-coated member according to claim 8, wherein peak intensity I_{Al} of Al near 1400 eV, peak intensity I_{W} of W near 1750 eV and peak intensity I_{Co} of Co near 800 eV in the observation data of said binding layer with Auger electron spectroscopy are in such relations that the ratio $I_{\text{W}}/I_{\text{Al}}$ is in a range from 0.1 to 0.5 and ratio $I_{\text{Co}}/I_{\text{Al}}$ is in the range from 0.1 to 0.5.

12. (Original) The surface-coated member according to claim 8, wherein concentrations of W and Co in the base body comprising hard alloy are higher on the surface than inside of the base body.

13. (Original) The surface-coated member according to claim 8, wherein concentrations of W and Co in said binding layer are twice or more higher than the concentrations of W and Co in said TiCN layer and said Al_2O_3 layer.

14. (Original) The surface-coated member according to claim 8, wherein the adhesion force of said Al_2O_3 layer is 10 to 50 N in Scratch examination.

15. (Original) The surface-coated member according to claim 8, which is a cutting tool used for machining a workpiece by bringing a cutting edge thereof into contact with the workpiece.

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16. (Canceled)

17. (Currently amended) The surface-coated member according to claim [[16]] 22, wherein the width of crack observed in the lower structure of said TiCN layer is 1/2 or smaller as width of crack observed in the upper structure.

18. (Canceled)

19. (Currently amended) The surface-coated member according to claim [[18]] 22, wherein the thickness t_1 of said lower TiCN layer is in a range of $1 \mu\text{m} \leq t_1 \leq 10 \mu\text{m}$, and the thickness of said upper TiCN layer is in a range of $0.5 \mu\text{m} \leq t_2 \leq 5 \mu\text{m}$, while two values of thickness satisfy an inequality $1 \leq t_1/t_2 \leq 5$.

20. (Currently amended) The surface-coated member according to claim [[18]] 22, wherein said TiCN layer comprises TiCN grains having a stringer structure extending at right angles to the surface of said base body while mean crystal width of the TiCN grains that constitute said upper TiCN layer is larger than the mean crystal width of the TiCN grains that constitute said lower TiCN layer.

21. (Original) The surface-coated member according to claim 20, wherein the mean crystal width w_1 in the upper layer of said TiCN layer is from 0.2 to 1.5 μm , and the mean crystal width w_2 in said lower TiCN layer is 0.7 times or less as the mean crystal width w_1 in said upper TiCN layer.

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22. (Currently amended) ~~The A surface-coated member according to claim 18 comprising the following (2a) and (2b):~~

(2a) the surface-coated member comprises a base body and a hard coating layer made of at least a TiCN layer and an Al₂O₃ layer formed on the surface of the base body in this order; and

(2b) a TiCN layer, that is observed on the periphery of the base body exposed at the center of an abrasion dent on the surface in Calotest, includes a lower structure where crack width is small or zero, and an upper structure where crack width is larger than that of the lower structure, observed on the periphery of said lower structure.

wherein said TiCN layer comprises at least two layers of a lower TiCN layer where crack width is zero or small observed on the periphery of the base body that is exposed at the center of said abrasion dent, and an upper TiCN layer where crack width is larger than that of said lower TiCN layer observed on the periphery of said lower TiCN layer.

wherein, when the composition of the TiCN layer is expressed as Ti(C_{1-x}N_x), a value of x is in a range from 0.55 to 0.80 in said lower TiCN layer and in a range from 0.40 to 0.55 in said upper TiCN layer.

23. (Currently amended) The surface-coated member according to claim [[16]] 22, wherein the adhesion force of said Al₂O₃ layer is from 10 to 50N as measured in scratch examination.

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24. (Currently amended) The surface-coated member according to claim [[16]] 22, wherein observation of an abrasion dent in Calotest shows cracks existing in a region from the interface of said Al_2O_3 layer with said TiCN layer to the inside of the Al_2O_3 layer.

25. (Original) The surface-coated member according to claim 8, which is a cutting tool used for machining a workpiece by bringing a cutting edge thereof into contact with the workpiece.

26. (Canceled)

27. (Currently amended) The surface-coated member according to claim [[26]] 31, wherein a TiCN layer, that is observed on the periphery of the base body exposed at the center of an abrasion dent on the surface in Calotest, includes a lower structure where crack width is small or zero, and an upper structure where crack width is larger than that of the lower structure, observed on the periphery of said lower structure, and

a ratio L_U/L of the length L_U in the radial direction of said upper structure to the length L in the radial direction of the entire TiCN layer ($L = L_U + L_L$, where L_L is length in the radial direction of said lower structure) is in a range from 0.05 to 0.15.

28. (Currently amended) The surface-coated member according to claim [[26]] 31, wherein the titanium carbonitride grains have a mean aspect ratio of 2 or higher when the crystal grains are observed from the surface.

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29. (Currently amended) The surface-coated member according to claim [[28]] 31, wherein the mean length of long axis of said titanium carbonitride grains is 1 μm or less when said titanium carbonitride grains are observed from the direction of surface.

30. (Canceled)

31. (Currently amended) ~~The A surface-coated member according to claim 30 comprising the following (3a) and (3b):~~

(3a) the surface-coated member comprises a base body and a hard coating layer comprising at least one TiCN layer formed on the surface of the base body;

(3b) said TiCN layer has, at least in a part thereof, titanium carbonitride grains extend in a direction perpendicular to the surface of said base body and shows a stringer structure when vertical cross section is observed; and

(3c) said TiCN layer includes a fine grained titanium carbonitride layer that shows a needle-like structure extending in random directions when observed on the surface.

wherein the surface of said fine grain titanium carbonitride layer is coated with an upper titanium carbonitride layer of which titanium carbonitride grains have a larger mean crystal width than that in said fine grain titanium carbonitride layer, and surface of said upper titanium carbonitride layer is coated with an aluminum oxide layer,

wherein the thickness t_1 of said fine grain titanium carbonitride layer is in a range of $1\ \mu\text{m} \leq t_1 \leq 10\ \mu\text{m}$ and the thickness t_μ of said upper titanium carbonitride layer is in a range of $0.5\ \mu\text{m} \leq t_\mu \leq 5\ \mu\text{m}$ ~~$0.5\ \mu\text{m} < t_\mu < 5\ \mu\text{m}$~~ while two values of thickness satisfy an inequality $1 \leq t_1/t_\mu \leq 5$.

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32. (Currently amended) The surface-coated member according to claim [[26]] 31, wherein the adhesion force of said Al_2O_3 layer is 10 to 50 N in Scratch examination.

33. (Currently amended) The surface-coated member according to claim [[26]] 31, which is a cutting tool used for machining a workpiece by bringing a cutting edge thereof into contact with the workpiece.